Space Weather Technical Forecast

Issued on Thursday, 08 August 2024 at 12:47 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Further M-class flares expected with a chance of isolated X-class flares. Chance of G1/Minor geomagnetic storms Day 3 (10 Aug).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate to High solar activity with several M-class flares observed, reaching a peak of M5.0 at 07/1854 UTC from AR3777 just west of centre disc and the second largest an M4.5 flare at 07/1350 UTC from AR3774, just slightly further west of AR3777. There are eleven sunspot regions on the visible disc. AR3780 remains the largest region on the disc, with a large negative leader spot, but also a proliferation of small spots amongst a broad area of plage to its south and southwest, however the weak delta to the west of its main spot appears to have faded. AR3774 and AR3777, either side of centre disc have also seen any sign of any delta configurations fade, however both remain moderately sized regions with the potential for notable flare activity. AR3781 in the northeast has seen any growth stall. AR3782 near the east limb has now been numbered, however the trailer region of this spot remains difficult to see and further details are likely to become evident as it rotates into view. The new region in the northeast continues to show some mostly minor growth.
Two potentially Earth directed CMEs occurred in the past 24 hours in associated with the two M-class flares mentioned above. The first produced a complex halo and may have coincided with a far sided event, complicating analysis. ENLIL analysis gives an arrival time late morning on Day 3 (10 Aug) but this is prone to high uncertainty due to interference on coronagraph imagery from the potential aforementioned far sided event. The second is a possible arrival later on Day 3 (10 Aug). Confidence in timings for both the CMEs is low.
Other CMEs were also evident in imagery. These included one to the northwest, from the filament eruption north of AR3775 at around 07/0120 UTC, and a further CME off the southeast disc that had an unknown source location, but perhaps the C-flaring of AR3780. This C-flaring occurred coincidently with the M1.8 flare of AR3774, however this is likely too far west to be the source of this CME. Another CME was observed from over the northeast limb. These are all likely to miss, however glancing influences are possible from the northwest filament CME on Day 3 (10 Aug).

Solar Wind / Geomagnetic Activity: Slow-ambient solar wind conditions mostly persisted through the period. Density remained at or below average. Interplanetary Magnetic Field, Bt, was Weak, below 6nT, while the north-south component was Weak and variable in direction, between -6nT and +6nT. Phi angle was negative (towards the Sun). Geomagnetic activity remained Quiet to unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 remained at background below the S1 Minor Radiation Storm threshold. High energy electron flux (greater than 2MeV) observed at GOES16 was also at background. The 24-hour fluence was below the Active threshold with 1.35e6 integrated pfu observed at 08/0000 UTC.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate to High solar activity is forecast to continue, with occasional M-class flares expected and a slight chance of isolated X-class flares.

Solar Wind /Geomagnetic Activity: Two CMEs have occurred in the past 24 hours which are likely to have an Earth-directed component. The first CME may have coincided with a far sided event, complicating analysis. Confidence in arrival times of these CMEs is currently very low, but arrivals possible from Day 3 (10 Aug). Additionally the filament eruption CME which left the Sun on 07 Aug is expected to pass close later on Day 3 (10 Aug), with glancing impacts possible. Background slow-ambient winds are expected throughout with just a slight chance of connecting to any fast wind from the small positive polarity coronal hole 57 by the end of the period. Geomagnetic activity is expected to be mostly Quiet initially, with a chance of isolated Unsettled intervals. However, there is a chance of Active to G1 Minor Storms from Day 3 (10 Aug) due to any CME influence or coronal hole onset, with a slight chance of G2 Moderate storms if these events should co-align.

Energetic Particles / Solar Radiation: High energy proton flux, as observed by GOES-18, is expected to persist at background throughout the period. Any strong flares will bring the potential for a slight chance of reaching/exceeding the S1 Minor Radiation storm level. The high energy electron flux is forecast to be at mostly background levels. The associated 24-hour fluence is expected to remain below the Active threshold (1e8 integrated pfu).

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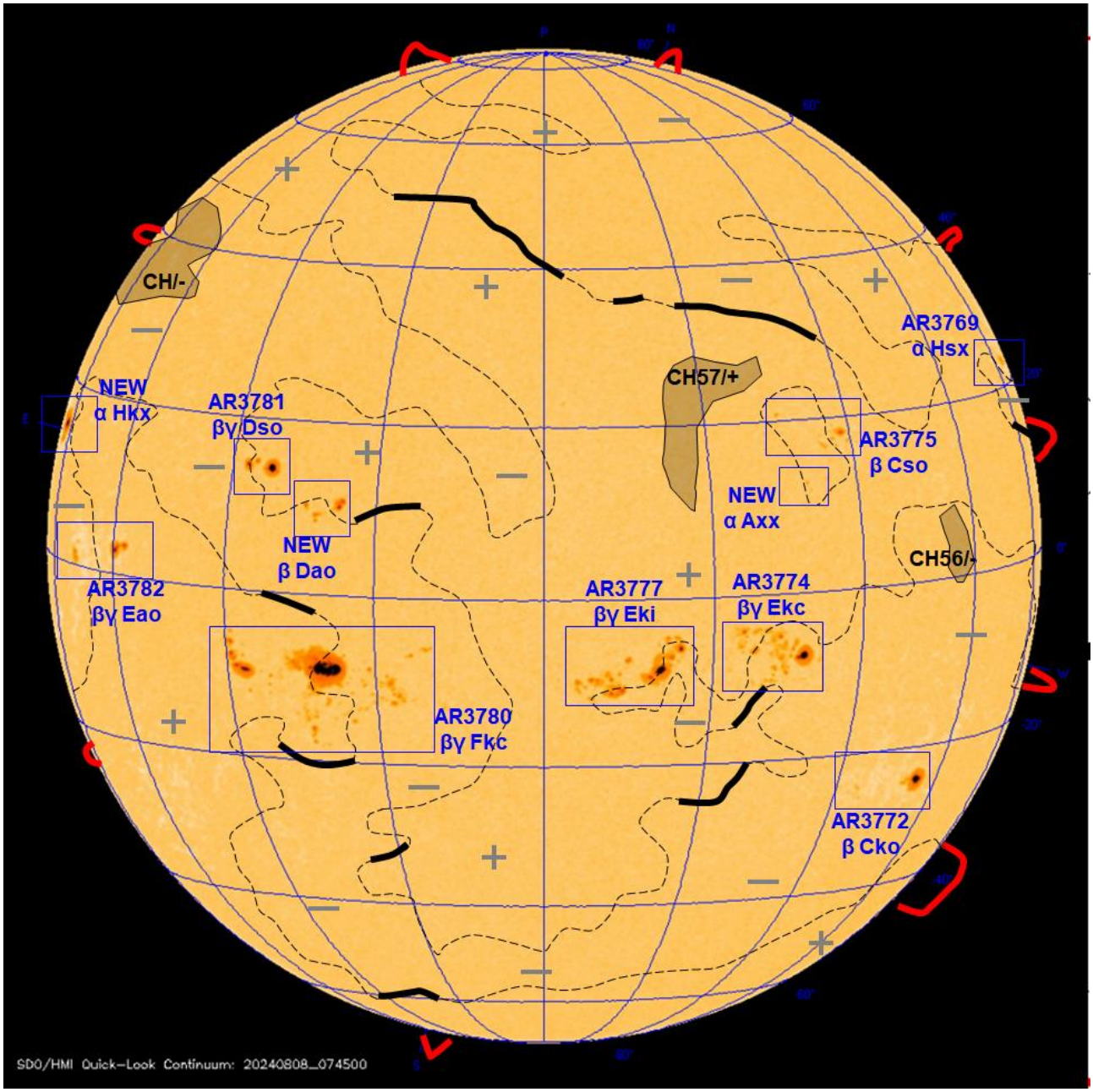
Figure 1. Solar Analysis Valid 0800 UTC, 8 August 2024.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A CME occurred in conjunction with the M4.5 flare from AR3774 at 07/1350UTC and is likely to have an Earth-directed component. This CME produced a complex halo and may have coincided with a far sided event, complicating analysis. Initial ENLIL analysis gives an arrival time late morning on Day 3 (10 Aug) but this is prone to high uncertainty due to interference on coronagraph imagery from the potential aforementioned far sided event.
A second CME also occurred in association with the M5.0 flare from AR3777 at 07/1854UTC and also likely has an Earth-directed component. Relevant coronograph imagery indicated a possible arrival later on Day 3 (10 Aug) or perhaps Day 4 (11 Aug). Confidence in this timing is low.
Several CMEs have occurred off the Earth-Sun line in recent days, which may cause slight transient glancing effects over the coming days, especially later in the period. Notably, a filament eruption on 07th Aug from the northwest disc, just north of AR3775, which is expected to miss, but pass close to Earth on Day 3 (10 Aug).
The next coronal hole fast wind enhancement is likely to be from any influence of CH57/+. Despite being a recurrent hole, and large on the previous rotation, no notable enhancement was observed on its previous passage. However there remains a slight chance of a connection, with winds possibly increasing towards Day 3 (10 Aug).

Geomagnetic activity is expected to be mostly Quiet initially, with a chance of isolated Unsettled intervals. However, there is a chance of Active to G1 Minor Storms from Day 3 (10 Aug) due to any CME influence or coronal hole onset, with a slight chance of G2 Moderate storms if these events should co-align.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	15	50	20
Strong	G3	No	1	1	10	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
07/1820 UTC	Partial	M4.5 flare from AR3774	SW	660 km/s	10/0600 UTC	Low confidence due to far sided event interfering with coronagraph imagery

Figure 2: MOSWOC ENLIL ensemble data showing CME impact on the 10th. However Enlil has a poor representation of current conditions with an anomalous coronal hole fast wind.

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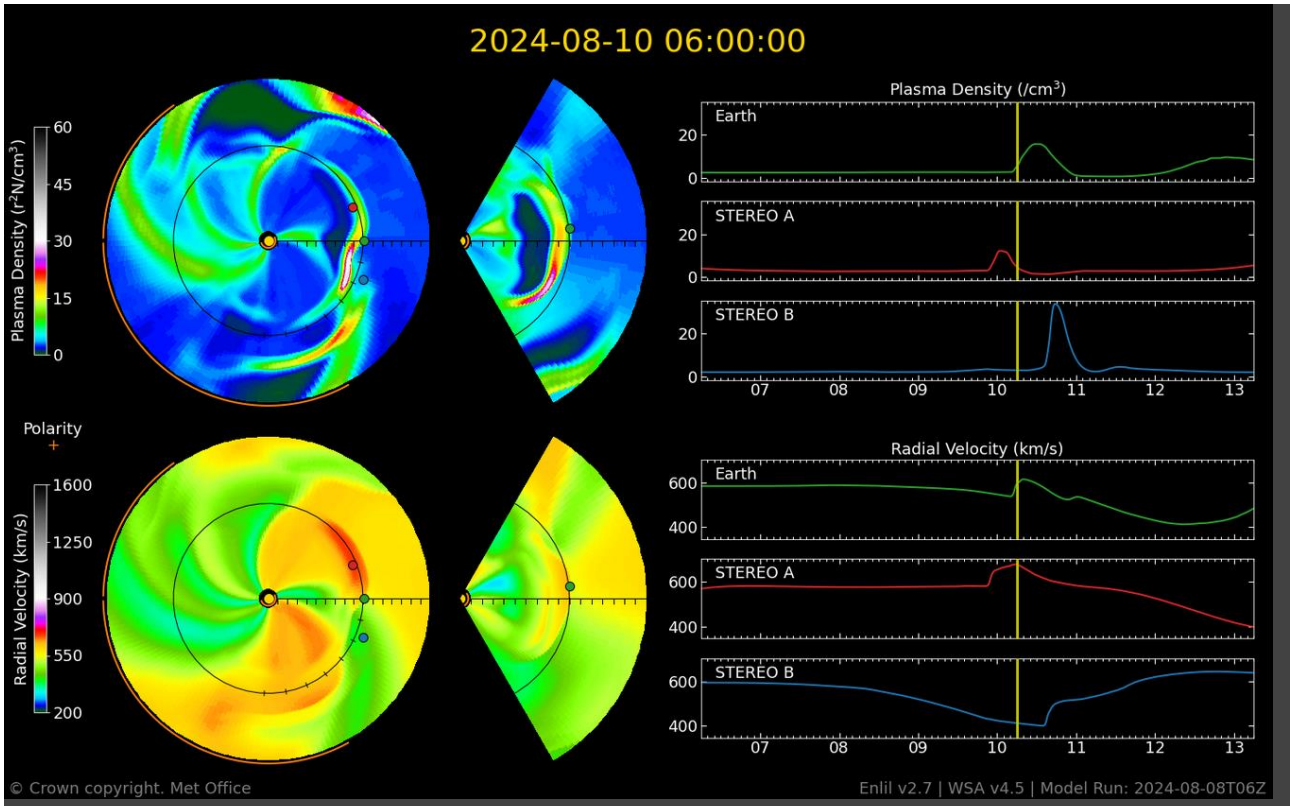

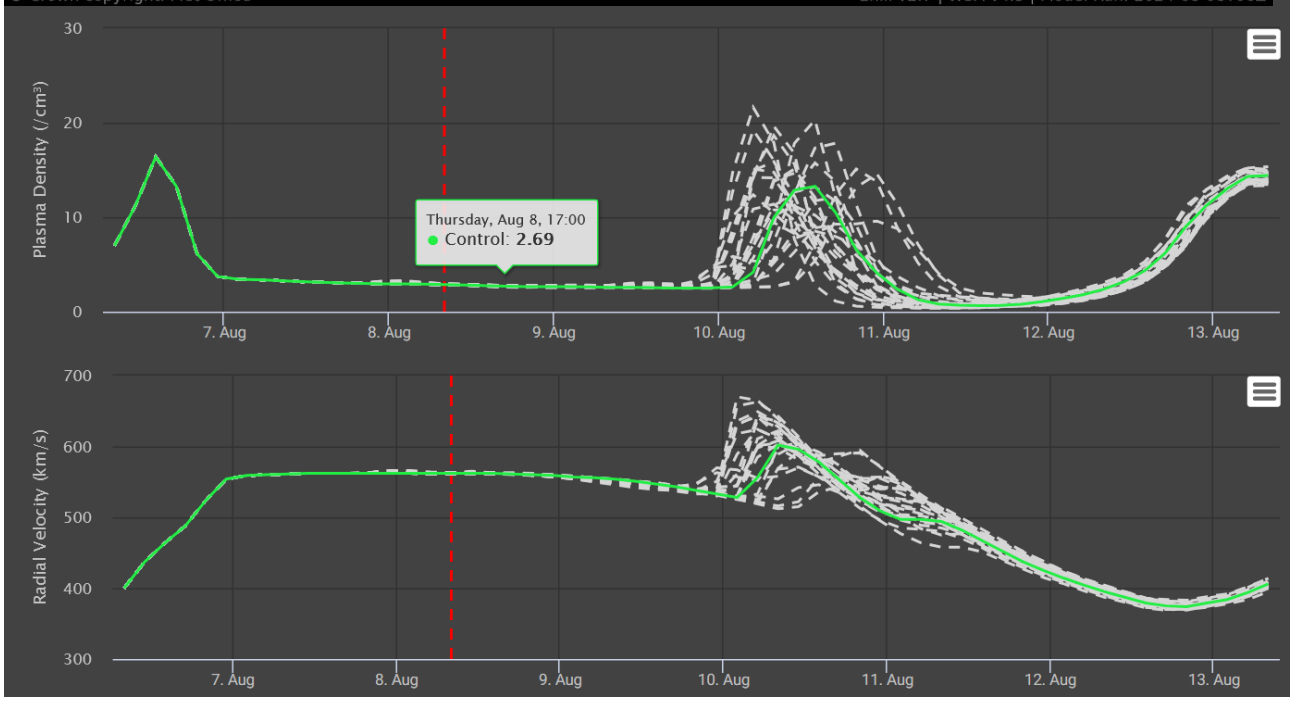

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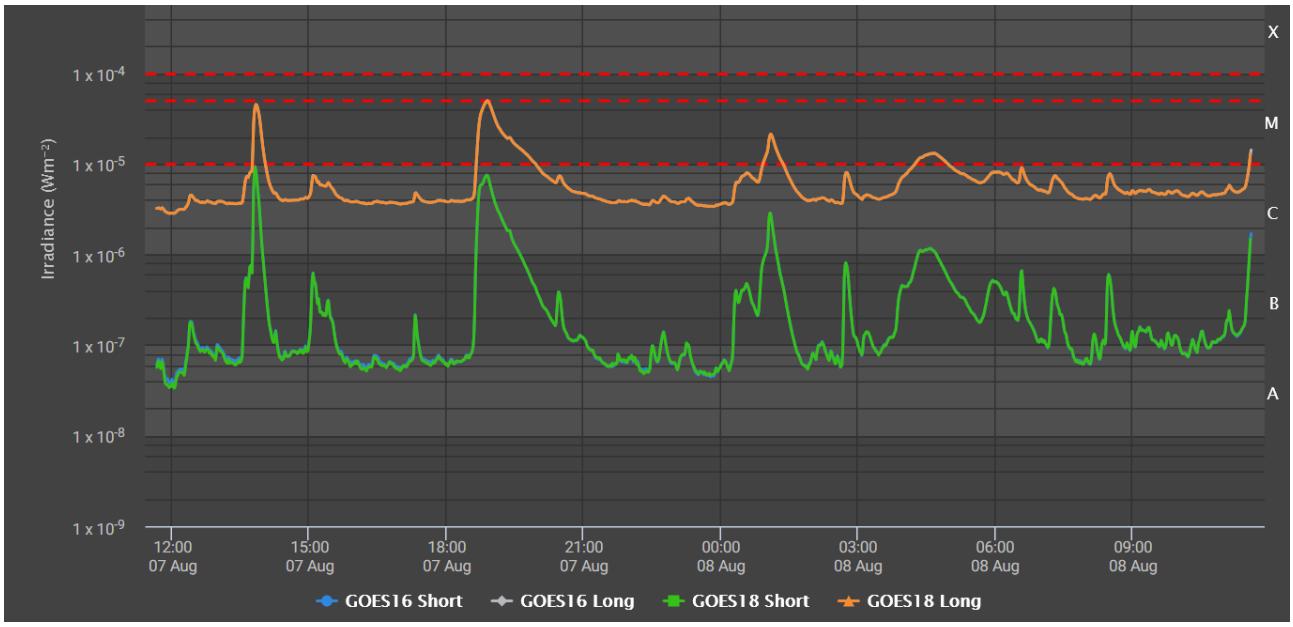
Radio Blackouts - X-Ray Flares:
Solar activity has been Moderate with four M-flares observed, with peak flare reaching M5.0 at 07/1854 UTC from AR3777. Further M-class flares are expected with a slight chance of isolated X-class flares.
There are eleven sunspot regions on the visible disc. AR3780 remains the largest region on the disc, with a large negative leader spot, but also a proliferation of small spots amongst a broad area of plage to its south and southwest, with a weak delta to the west of its main spot no longer in evidence. AR3774 and AR3777 are also both remain moderately sized regions with the potential for notable flare activity. AR3777 in the southwest and AR3781 in the northeast have also lost a delta configuration in trailing spots. The two new regions, one to the northeast and one to the NW, both have shown some minor growth in recent hours. Another new region is rotating onto the northeastern limb and shows some significant magnetic looping on SDO-171 imagery, but will have to rotate further onto the disc for a proper analysis.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	90	80	80	80
Very Active	R3 to R5 X Class	No	20	20	20	20

Figure 3: X-ray flux plot at GEO from GOES satellite data.



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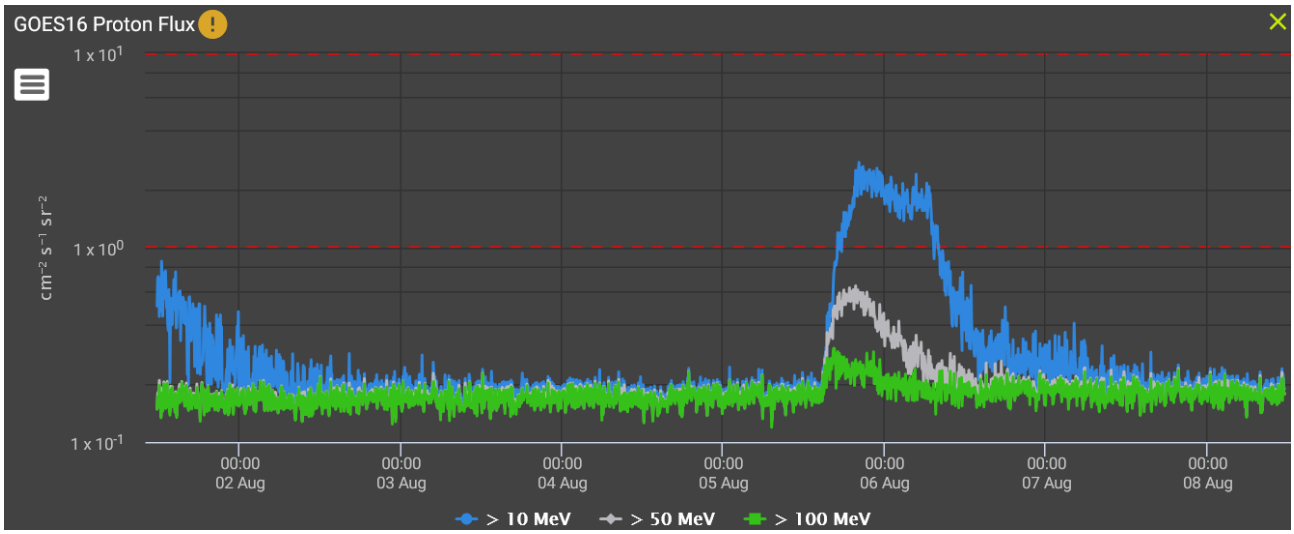
Solar Radiation Storms - (High Energy Protons):
High energy proton flux, as observed by GOES-18, was at background throughout the period. Any strong flares will bring the potential for a slight chance of reaching/exceeding the S1 Minor Radiation storm level.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	20	20	20	20
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Proton flux at GEO with little activity in past 24 hours.



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High Energy Electrons Event (≥ 2MeV):
High energy electron flux, as observed by GOES-16, is currently at background. In the absence of any notable fast wind arrivals, the observed flux is expected to remain at or near background level.
The associated 24hr electron fluence is expected to remain below Active (1e8 integrated pfu).

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: High energy electron flux at GEO and Met Office REFM output.

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